WateReuse California

Communications Collaborative Group

Thursday, December 9, 2021
12 p.m. – 1:30 p.m.

Virtual Meeting via Zoom

Thank you for joining!

WateReuse Communications Collaborative Group

Our Coordination Team

Rupam Soni, Chair
Metropolitan Water District of Southern California

Patsy Tennyson
Katz and Associates

Mark Millan
Data Instincts

Rebecca Rubin, Vice -Chair
Soquel Creek Water District

Gina Ayala
Orange County Water District

Melanie Mow Schumacher
Soquel Creek Water District

Today’s Agenda

WateReuse California Communications Collaborative Group

12:00 P.M.	**Welcome** *Rupam Soni | Metropolitan Water District* *Rebecca Rubin | Soquel Creek Water District*
12:05 P.M.	**Panel: Communicating about the LA Region’s Water Reuse Future – *Challenges and Opportunities*** *Join representatives from The Metropolitan Water District of Southern California, Los Angeles County Sanitation Districts, LADWP, LA Sanitation, and the Water Replenishment District for an interactive discussion.*
12:45 P.M.	**Update from California WateReuse Association’s Managing Director** *Jennifer West | WateReuse California*
12:55 P.M.	**A Glimpse at Water Research Foundation’s Study (4832) - Evaluation of CEC Removal by Ozone/BAC in Potable Reuse Applications** *Mark Millan | Data Instincts*
1:05 P.M.	**Pharmaceutical Subcommittee Update** *Sharon Green | Los Angeles County Sanitation Districts*
1:15 P.M.	**Media Update** *Rebecca Rubin | Soquel Creek Water District*
1:20 P.M.	**Round Table Discussion** *Gina Ayala | Orange County Water District*
1:30 P.M.	**Wrap Up** *Rebecca Rubin | Soquel Creek Water District*

Communicating about
the LA Region's Water Reuse Future:
Challenges and Opportunities

Moderators: Mark Millan/Data Instincts and Patsy Tennyson/Katz & Associates

Our Panelists

- Rupam Soni – Metropolitan Water District
- Basil Hewitt – LA County Sanitation Districts
- Stephanie Spicer – LA Dept of Water & Power
- Pamela Perez – LA Sanitation
- Angie Mancillas - Water Replenishment District


Joseph Jensen Water Treatment Plant (Metropolitan)
Los Angeles Aqueduct Filtration Plant (LADWP)
Junction Structure
Spreading Grounds
WIN4All injection and extraction areas
RRWP Conveyance System
City of Los Angeles Operation Next
San Fernando Groundwater Basin Spreading Grounds and Injection Wells
F.E. Weymouth Water Treatment Plant (Metropolitan)
Santa Fe Spreading Grounds
Pasadena
Hollywood
Main San Gabriel Basin
Los Angeles
West Covina
Pomona
LA Forebay Injection Wells
LAX
City of Los Angeles Hyperion Water Reclamation Plant
Montebello Forebay Spreading Grounds & Inland Injection Wells
Yorba Linda Feeder (Existing)
Central Basin
Robert B. Diemer Water Treatment Plant (Metropolitan)
West Coast Basin
Seawater Barrier Injection and New Inland Injection Wells
East Orange County Feeder (Existing)
Redondo Beach
Orange County Groundwater Basins Spreading Grounds
JWPCP (LACSD)
Anaheim
New Inland Injection Wells
Advanced Water Treatment Facility (RRWP)
Pacific Ocean
Santa Ana
Long Beach
Orange County Basin

Thank you!

WateReuse California

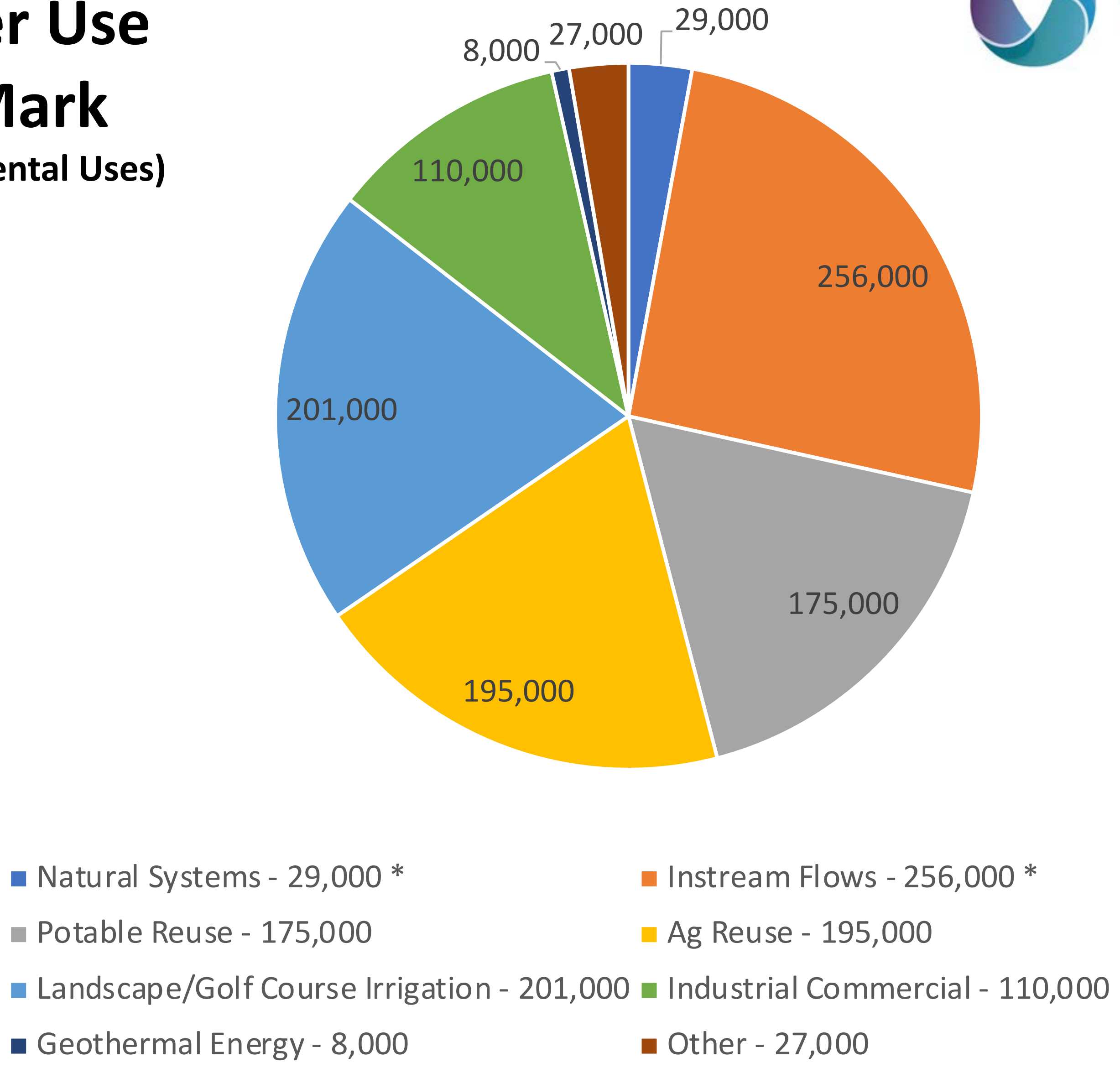
Communication Collaborative Group

December 9, 2021

Jennifer West

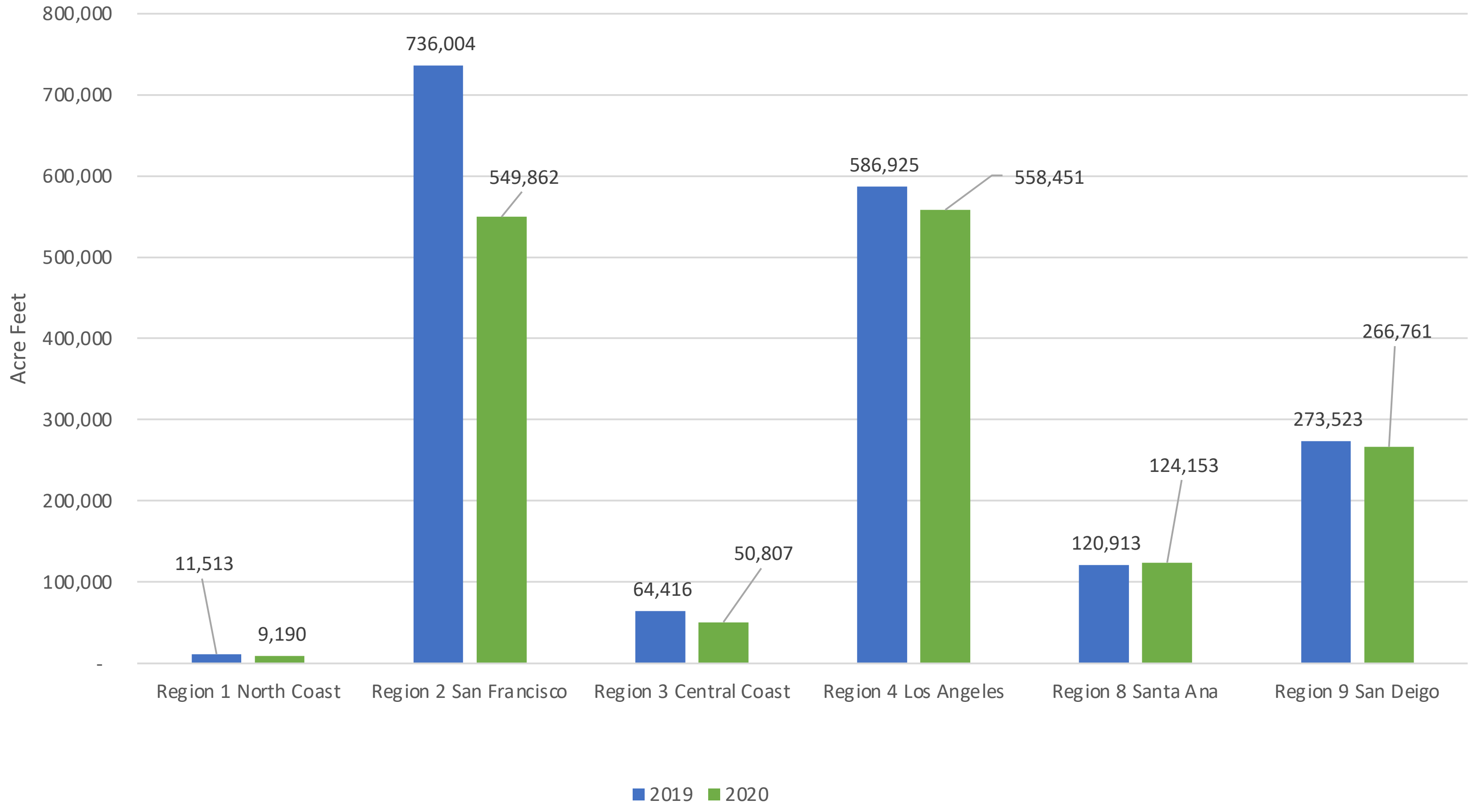
Recycled Water Use Hits 1 MAF Mark

(2020 Title 22 + Environmental Uses)



*Not included as Title 22 use of recycled water. Water Board reports 728,000 AFY in Title 22 uses

2019- 2020 Effluent Discharge to Ocean and Enclosed Bays
14% Decrease in 2020



WRCA Recycled Water Mapping Project

Infrastructure Investment and Jobs Act

- **$450 million** -- Bureau of Reclamation: Large Scale Water Recycling
  - Large Projects ($500 Million+) located in one of 17 Western states
  - Must complete technical and financial feasibility study
  - Grants can be ¼ of total project cost

- **$550 Million --** Title XVI Water Reclamation & Reuse Grant Program
  - Title XVI-WIIN competitive grants for smaller projects
  - Earmark for legacy Title XVI projects
  - Grants capped at $20 million or ¼ project cost, whichever is less

** 2026 funding deadline both programs (maybe extended)*

Federal Investment Continued

- **SRF Funding** -- Increases CWSRF and DWSRF in base funding by $11.7 billion
  - CA CWSRF to increase funding capacity – by at least $100 million
- Reauthorizes the **Pilot Program for Alternative Water Source Grants**: Expected $125 million in FY 22 …but not included yet.
- Directs the Administration to set up a **federal interagency working group on water reuse**.

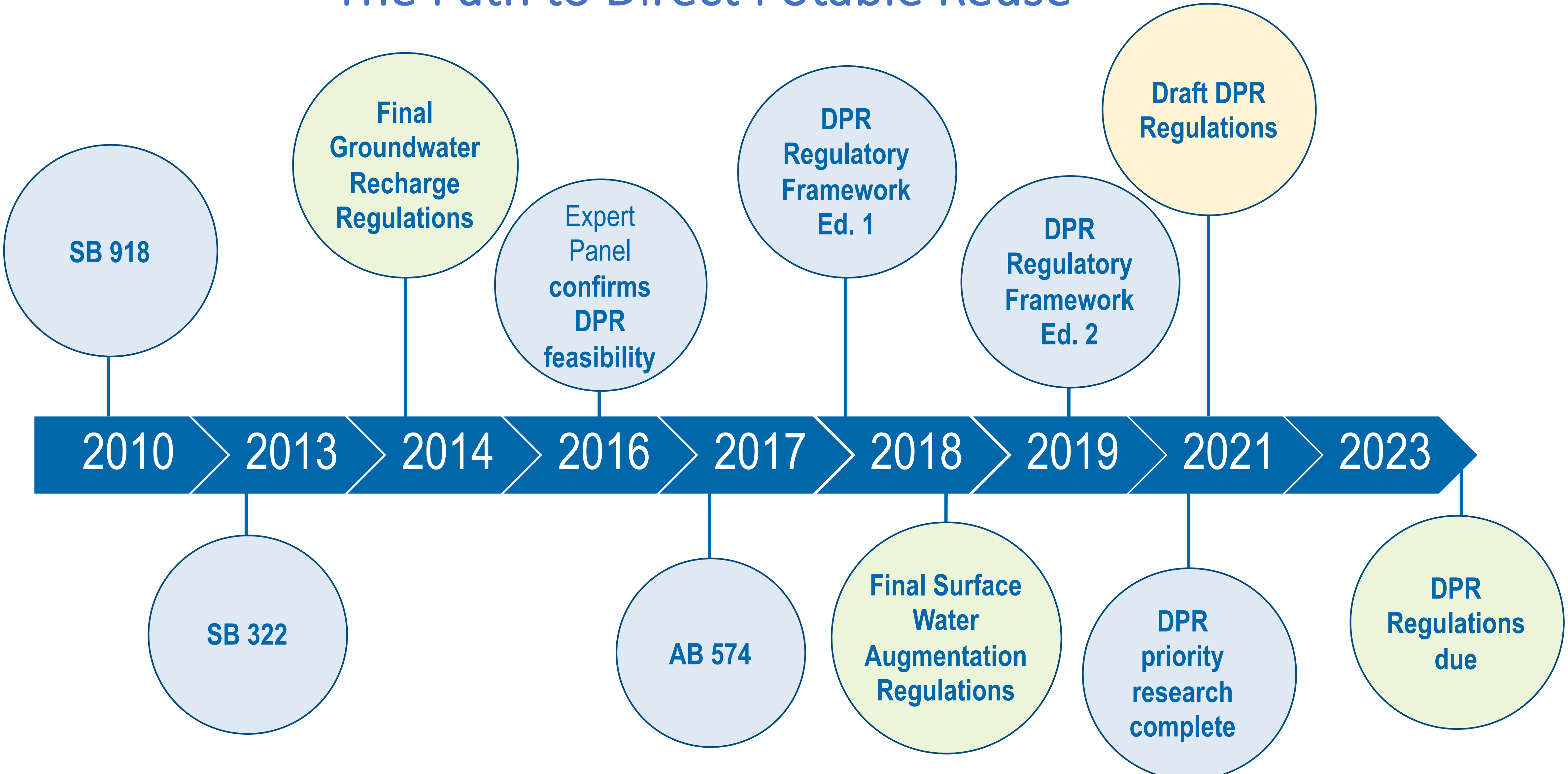
(Contact Greg Fogel, WRA Policy Director, gfogel@watereuse.org)

California Budget Recycled Water

- **$200 million** 2021-22 Recycled Water and Groundwater Cleanup
  - $50 million City of San Diego
- Proposed: **$200 million 2022-24** Recycled Water and Groundwater Cleanup
  - WRCA Focus:
  - Increase out year funding
  - Decouple funding from groundwater cleanup
- Additional funding available for CWSRF state match

WATEREUSE CALIFORNIA

The Path to Direct Potable Reuse



DPR Comments and SWB Responses

(August 2021 draft)

Differentiating between RWA and TWA

(New language allows RWA blending credits/higher allowable TOC and log reduction credits for SWTP. Recommend additional benefits of RWA should extend to other elements of the regs – Ex. source control and staffing)

Document/understand the need for the pathogen LRV requirements

(SWB released addendum explaining method behind 20:14:15 LRV . Recommend that the Expert Panel further review this justification since it seems that DDW did not use the information gathered in DPR-2 on raw wastewater concentrations, nor follow the approach proposed in DPR-1 for evaluating microbial risk.)

Specify performance goals and reduce prescriptive design criteria: Ex BAC/O3

(New language allows greater flexibility for the location of the O3/BAC and included additional performance goals [with 1-log reduction of acetone, formaldehyde, and NDMA]. Recommend to further reduce the prescriptive design criteria in favor of the performance requirements for chemical control, similar to AOP in the groundwater regulations that did not specify a specific method.)

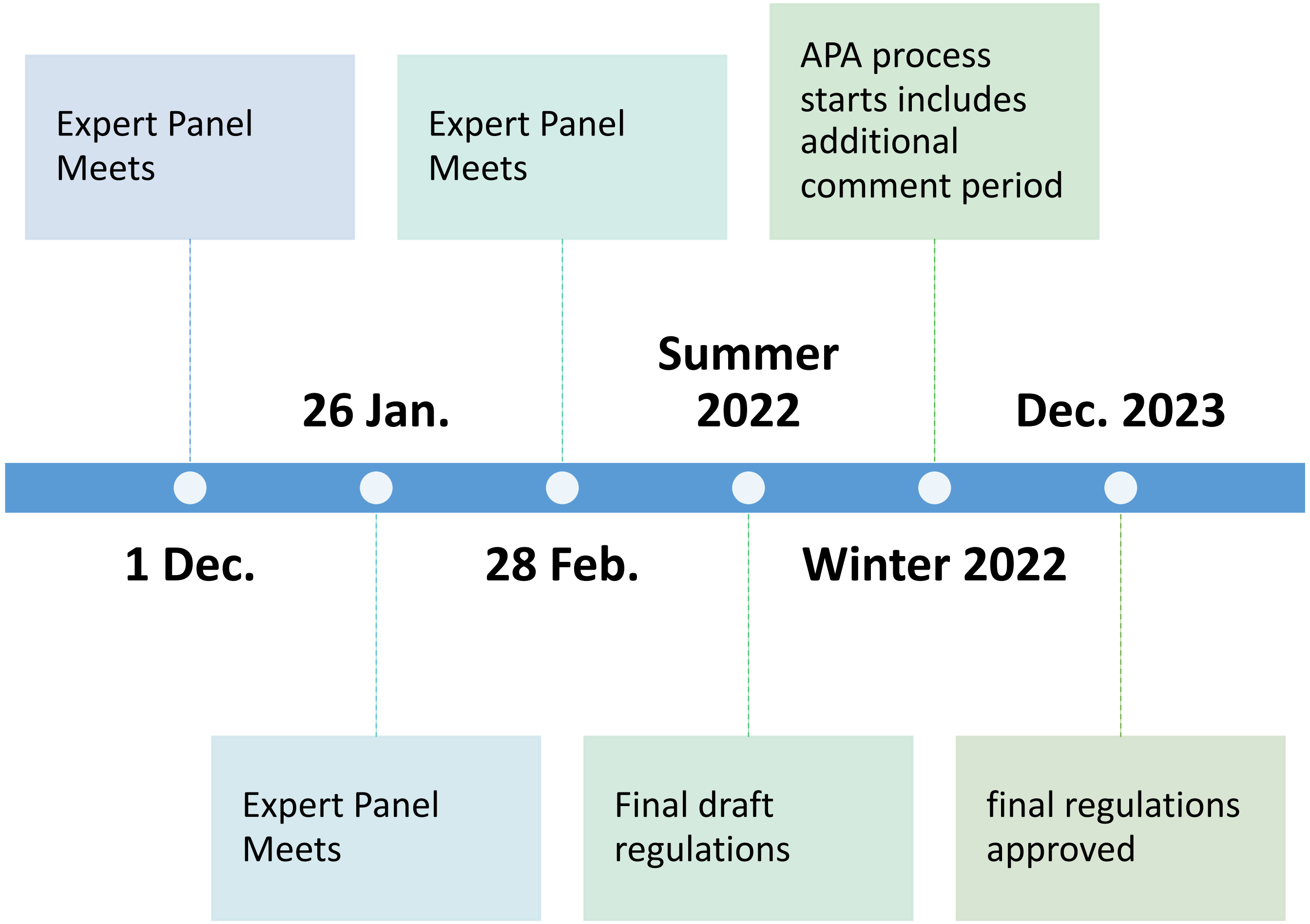
Streamline redundant plans

AWT 5 Operators 24/7: revise to allow flexibility

(New language allows project to demonstrate equivalent operations oversight Section 64669.35)

Alternative Clause expand beyond just chemical control

(Recommend the scope of the clause extend beyond just chemical control (Section 64669.50) to entire regulations, similar to the alternative clause in groundwater recharge reg.)


Expert Panel Meets
Expert Panel Meets
APA process starts includes additional comment period
Summer 2022
26 Jan.
Dec. 2023
1 Dec.
28 Feb.
Winter 2022
Expert Panel Meets
Final draft regulations
final regulations approved

DWR Recycled Water Draft Recommendations

RW Irrigation “consistent with MWELO” – Up to 1.0 ETO	RW Variance for High TDS – Agency wide variance for TDS 1000+ -- up 0.2	Potable Reuse Credit (10 to 15%)
• WRCA led MWELO recycled water committee in 2018-20 update to maintain RW 1.0 ETO	• WRCA, UC Riverside, So. Cal Salinity Coalition developed white paper on high TDS RW	• WRCA and environmentalists developed method for calculation

*Water Board must adopt DWR recommendations -- 2022

Final Residential Indoor Water Use Standard

- 55 gallons per capita per day by 2023
- 47 gallons per day by 2025
- 42 gallons by 2030 and beyond

DWR-Water Board study submitted to the Legislature last week.

AB 1434 (Friedman) is vehicle for implementation.

Questions?

Jennifer West

Jwest@watereuse.org

(916) 496-1470

The Challenge: **Explaining CEC removal processes to the public**

Data *instincts*
Public Outreach Consultants

Mark Millan

Evaluation of CEC Removal by Ozone/BAC Treatment in Potable Reuse Applications

WRF-4832

TASKS

1. Prioritized Literature Review on Ozone/BAF
2. Develop Health-Based Water Quality Goals for Ozone/BAF
3. Synthesis of Results and Additional Testing
4. Develop Design and Operational Guidelines
5. Develop Public Outreach Documents

How do we explain these complex systems to the public?

Draft Final Report

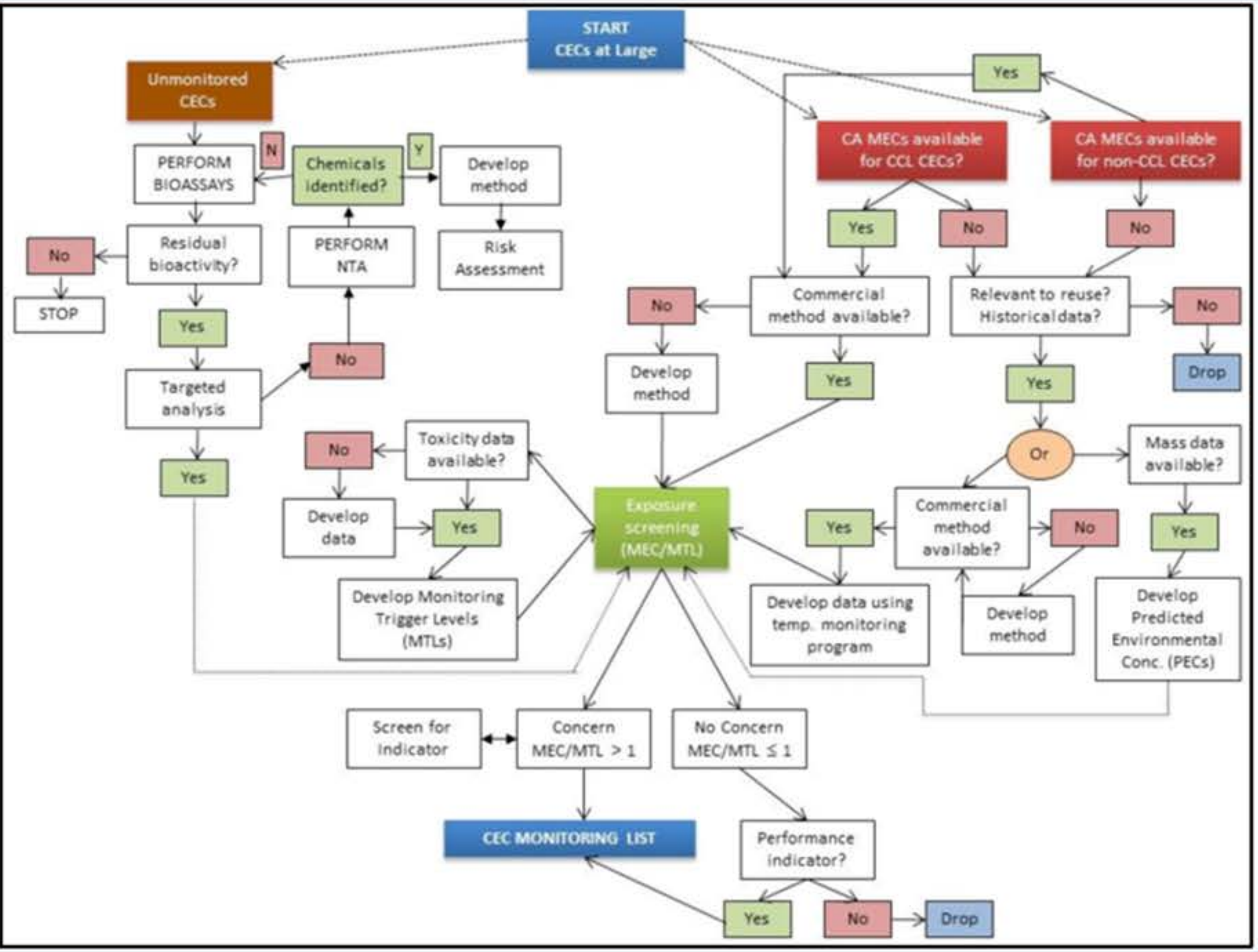
Monitoring Strategies for Constituents of Emerging Concern (CECs) in Recycled Water

Recommendations of a Science Advisory Panel

Panel Members
Jörg E. Drewes (*Chair*), Paul Anderson, Nancy Denslow, Walter Jakubowski, Adam Olivieri, Daniel Schlenk, and Shane Snyder

Convened by the
State Water Resources Control Board

January 31, 2018
Sacramento, California



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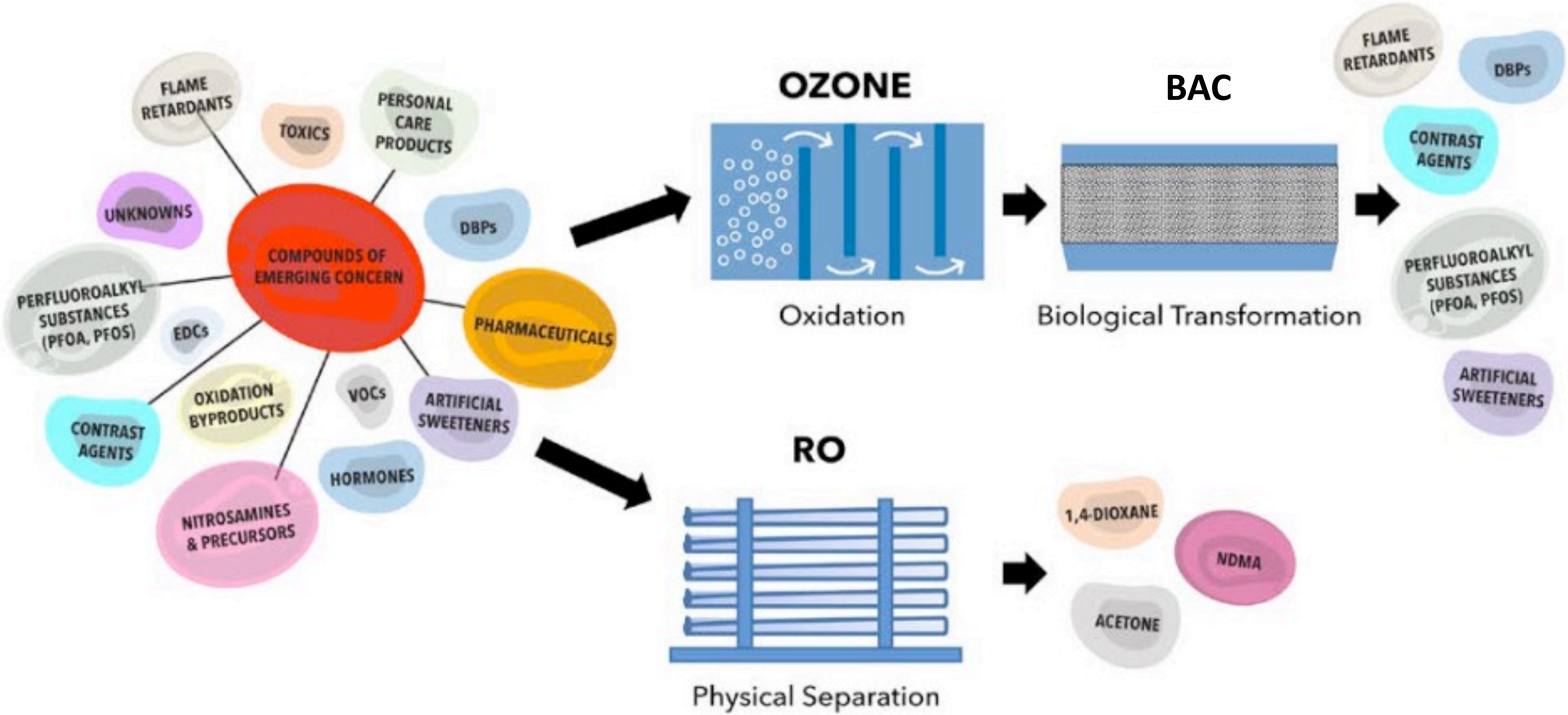


FLAME RETARDANTS
TOXICS
PERSONAL CARE PRODUCTS
UNKNOWNS
DBPs
COMPOUNDS OF EMERGING CONCERN
PERFLUOROALKYL SUBSTANCES (PFOA, PFOS)
EDCs
PHARMACEUTICALS
OXIDATION BYPRODUCTS
VOCs
ARTIFICIAL SWEETENERS
CONTRAST AGENTS
HORMONES
NITROSAMINES & PRECURSORS
OZONE
Oxidation
BAC
Biological Transformation
FLAME RETARDANTS
DBPs
CONTRAST AGENTS
PERFLUOROALKYL SUBSTANCES (PFOA, PFOS)
ARTIFICIAL SWEETENERS
RO
Physical Separation
1,4-DIOXANE
NDMA
ACETONE

Highlights:

Is Ozone/BAC suitable for potable reuse (i.e. surface water augmentation, groundwater recharge, raw water augmentation)? Yes. Ozone/BAC is a suitable advanced treatment process for all potable reuse applications.

What is the fate of CECs through ozone and Ozone/BAC based treatment?
Provides an excellent barrier to many types of CECs with removals of greater than 50%. Further treatment may be necessary to meet health-based goals for compounds of industrial origins, such as PFAS.

Does Ozone/BAC do a better job against the bulk of CECs than RO?
Both Ozone/BAC and RO are considered best available technologies for addressing a majority of CECs. RO is more effective for removal of recalcitrant organics such as PFAS, whereas Ozone/BAC is not. On the other hand, Ozone/BAC provides a barrier for small molecular weight organics such as acetone, formaldehyde, and NDMA and is more effective at removing these types of compounds than RO.

Are there substantial cost differences between the use of Ozone/BAC and other treatment processes?
Generally speaking, an Ozone/BAC-based treatment train without RO (i.e. CBAT) is less expensive than an RO-based treatment train. This is even more true when brine management becomes a significant factor.

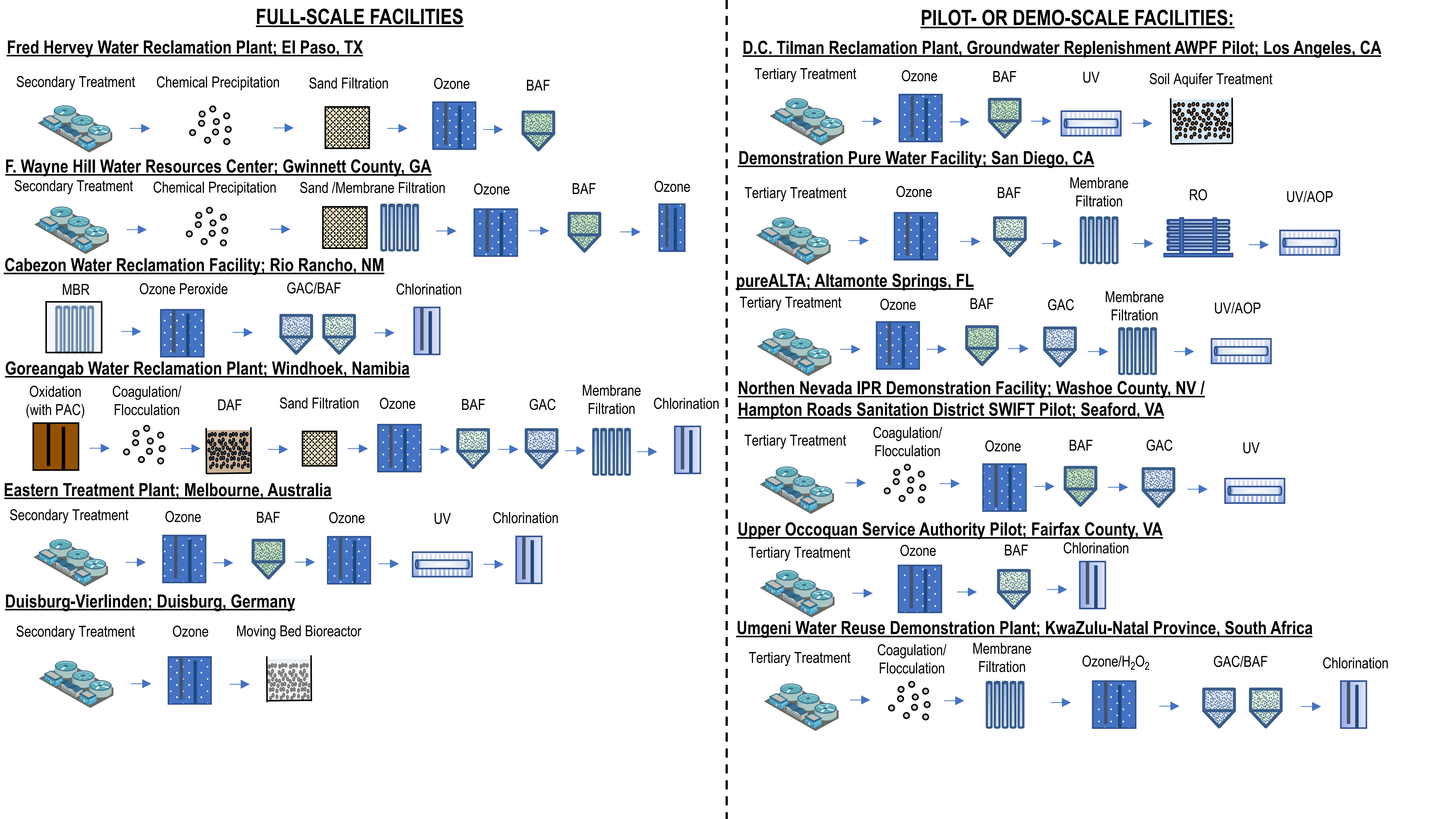
My takeaways:

- Remember the: "**The Right Water for the Right Use**"

- Clearly: **One Size Does Not Fit All**
  This is more like, what's "**The Right Treatment Train for your Location**"

- If near a coastline, brine discharge is possible through existing wastewater streams that are already permitted or could be

- But if you're inland, you're likely to consider an Ozone BAC approach just as Hampton Roads and OneWater Nevada have


FULL-SCALE FACILITIES
Fred Hervey Water Reclamation Plant; El Paso, TX
Secondary Treatment
Chemical Precipitation
Sand Filtration
Ozone
BAF
F. Wayne Hill Water Resources Center; Gwinnett County, GA
Secondary Treatment
Chemical Precipitation
Sand /Membrane Filtration
Ozone
BAF
Ozone
Cabezon Water Reclamation Facility; Rio Rancho, NM
MBR
Ozone Peroxide
GAC/BAF
Chlorination
Goreangab Water Reclamation Plant; Windhoek, Namibia
Oxidation (with PAC)
Coagulation/ Flocculation
DAF
Sand Filtration
Ozone
BAF
GAC
Membrane Filtration
Chlorination
Eastern Treatment Plant; Melbourne, Australia
Secondary Treatment
Ozone
BAF
Ozone
UV
Chlorination
Duisburg-Vierlinden; Duisburg, Germany
Secondary Treatment
Ozone
Moving Bed Bioreactor
PILOT- OR DEMO-SCALE FACILITIES:
D.C. Tilman Reclamation Plant, Groundwater Replenishment AWPF Pilot; Los Angeles, CA
Tertiary Treatment
Ozone
BAF
UV
Soil Aquifer Treatment
Demonstration Pure Water Facility; San Diego, CA
Tertiary Treatment
Ozone
BAF
Membrane Filtration
RO
UV/AOP
pureALTA; Altamonte Springs, FL
Tertiary Treatment
Ozone
BAF
GAC
Membrane Filtration
UV/AOP
Northen Nevada IPR Demonstration Facility; Washoe County, NV /
Hampton Roads Sanitation District SWIFT Pilot; Seaford, VA
Tertiary Treatment
Coagulation/ Flocculation
Ozone
BAF
GAC
UV
Upper Occoquan Service Authority Pilot; Fairfax County, VA
Tertiary Treatment
Ozone
BAF
Chlorination
Umgeni Water Reuse Demonstration Plant; KwaZulu-Natal Province, South Africa
Tertiary Treatment
Coagulation/ Flocculation
Membrane Filtration
Ozone/H_2O_2
GAC/BAF
Chlorination

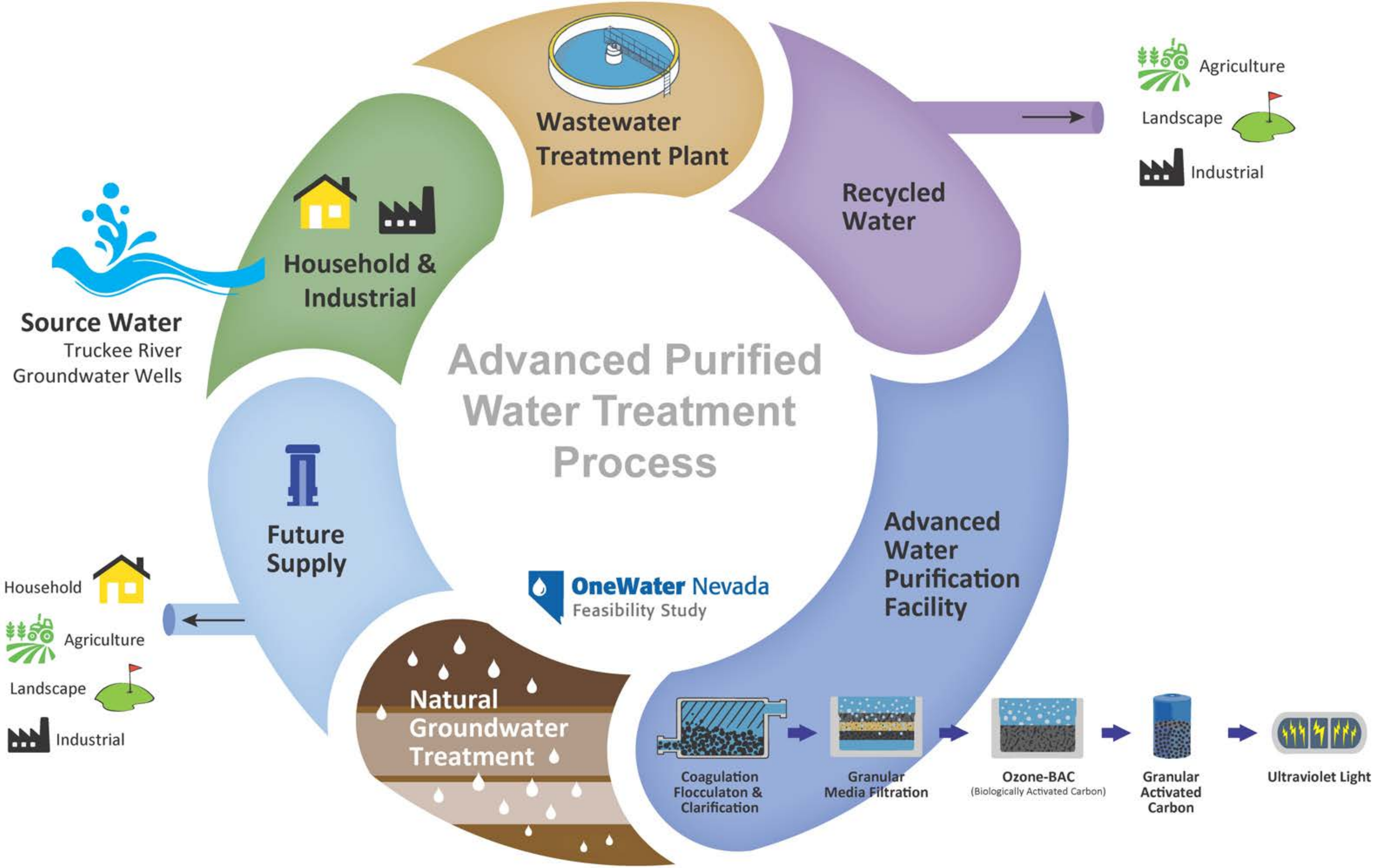

Advanced Purified
Water Treatment
Process
Wastewater
Treatment Plant
Recycled
Water
Agriculture
Landscape
Industrial
Household &
Industrial
Source Water
Truckee River
Groundwater Wells
Future
Supply
Household
Agriculture
Landscape
Industrial
Natural
Groundwater
Treatment
OneWater Nevada
Feasibility Study
Advanced
Water
Purification
Facility
Coagulation
Flocculaton &
Clarification
Granular
Media Filtration
Ozone-BAC
(Biologically Activated Carbon)
Granular
Activated
Carbon
Ultraviolet Light

Chart 4:

TOOLBOX OF UNIT PROCESSES FOR CBAT POTABLE REUSE TREATMENT TRAINS FOR DIFFERENT PROJECT TYPES

Project Type	Biological Treatment and Filtration	Ozone (CECs)	Ozone (CT for Disinfect.)	BAF	MF	GAC	IX	UV	UV/AOP	Pipeline Cl_2 + DWTP	Aquifer	Total Pathogen LRV (Reqd.)
Groundwater Injection	✓(TOC) ✓(CECs) ✓(Nutrients)	✓(CECs)		✓(TOC) ✓(CECs)	✓(Pathogen) (0/4/4)	✓(TOC) ✓(CECs)			✓(CECs) ✓(Pathogen) (6/6/6)		✓(TOC) ✓(CECs) ✓(Pathogen) (6/0/0)	12/10/10 (12/10/10)
Surface Water Augmentation	✓(TOC) ✓(CECs) ✓(Nutrients)		✓(TOC) ✓(CECs) ✓(Pathogen) (6/6/1)	✓(TOC) ✓(CECs)	✓(Pathogen) (0/4/4)	✓(TOC) ✓(CECs)	✓(Nutrients)		✓(CECs) ✓(Pathogen) (6/6/6)			12/16/11 (8/7/8)
Direct Potable Reuse	✓(TOC) ✓(CECs) ✓(Nutrients) ✓(Pathogen) (1/2.5/2.5)		✓(TOC) ✓(CECs) ✓(Pathogen) (6/6/1)	✓(TOC) ✓(CECs)	✓(Pathogen) (0/4/4)	✓(TOC) ✓(CECs)	✓(Nutrients)		✓(CECs) ✓(Pathogen) (6/6/6)	✓(TOC) ✓(CECs) ✓(Pathogen) (6/3/1 + 4/3/2)		23/24.5/16.5 (20/14/15)
Projects w/o Pathogen-Based Requirements	✓(TOC) ✓(CECs) ✓(Nutrients)	✓(CECs)		✓(TOC) ✓(CECs)		✓(TOC) ✓(CECs)		✓(CECs)				N/A

✓=TOC ✓=CECs ✓=Nutrients ✓=Pathogen Credit: anticipated log removal values (LRV) for Virus/Giardia/Cryptosporidium

[Total pathogen LRV requirements are based on California's current and draft potable reuse regulations]

These hypothetical treatment train examples are intended to illustrate the various tools that exist to achieve certain treatment goals. These alternative non-RO treatment trains need to demonstrate treatment equivalency in states such as California to comply with the potable reuse regulations.

GLOSSARY OF TERMS — Biological Aerated Filter (BAF) • Drinking Water Treatment Plant (DWTP) • Free Chlorine (Cl2) • Granular Activated Carbon (GAC) • Ion Exchange (IX) • Log Reduction Value (LRV) • Microfiltration (MF) • Ultraviolet (UV) • Ultraviolet Advanced Oxidation Process (UV/AOP)

My takeaways:

- Know your source water to determine best processes to meet regulations

- Select best elements to remove key constituents and surrogates for CECs removal

- Biggest Challenge Remains: Explaining these processes to the public in ways they can understand to make informed decisions to support or consent

- Our demonstrations sites, videos, and water tastings are still the best approach
- We will need a diverse spectrum of outreach tools

Evaluation of CEC Removal by Ozone/BAC Treatment in Potable Reuse Applications

THE CHALLENGE

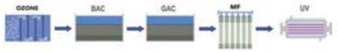
Potable reuse is now considered an integral component of water resource management in many communities around the world. The treatment solutions exist today to reliably produce safe drinking water from reclaimed water. Treatment trains with and without Reverse Osmosis (RO) are currently being evaluated and implemented for full-scale potable reuse applications. RO-based treatment trains pose significant implementation challenges for some utilities due to their relatively high capital and operating costs along with the difficulty of managing the co[illegible]ated waste streams when ocean discharge is no[illegible]ailable, as is the case with many inland applications. Al[illegible]atives to RO-based treatment trains often include Ozon[illegible]enhanced Biologically Active Carbon (Ozone/BAC) in a mu[illegible]ple-barrier approach. This is often referred to as Car[illegible] Advanced Treatment (CBAT). While it is important [illegible] recognize that there is not a "one size fits all" solution for potable reuse, Ozone/BAC-based treatment trains have been proven to produce a high-quality reclaimed water meeting drinking water standards at a significantly lower cost and environmental footprint than RO-based treatment trains.

Both Ozone/BAC-based and RO-based treatment trains for potable reuse are still relatively new, and there is a legitimate need to identify and address knowledge gaps and additional optimization needs with respect to public health, safety, and perception. While potable reuse regulations still do not exist in many countries, we do have expert guidance on pathogen log reduction compliance in locations like California and Australia. On the other hand, our understanding of Constituents of Emerging Concern (CECs) is still evolving. There is a need for utilities and regulators to have a health-based context to develop performance criteria for Ozone/BAC-based treatment trains s[illegible]ocus can be narrowed down to the most relevant and c[illegible] CECs.

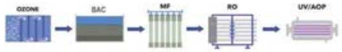
One of the greatest obs[illegible] to t[illegible] implementation [illegible] potable reuse project[illegible]inues t[illegible]e public percepti[illegible] and acce[illegible]RF-48[illegible]s focus[illegible]on developing tr[illegible] guideli[illegible]s to les[illegible]n conce[illegible] CECs while [illegible]abling bro[illegible] [illegible]lemen[illegible]ion of Ozone/BAC-based [illegible]atment [illegible]ins.

Chart 1:
EXAMPLES OF OZONE/BAC TREATMENT TRAINS FOR POTABLE REUSE

Carbon-Based Advanced Treatment —
Example treatment train for groundwater injection in Virginia at Hampton Roads Sanitation District



Ozone-BAC Full Advanced Treatment —
Example treatment train for direct potable reuse in California at the City of San Diego



THE RESEARCH

Factors for Consideration

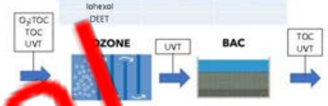
Identifying which CECs are both recalcitrant through an Ozone/BAC-based treatment train and toxicologically relevant is a key consideration for implementation. Many CECs that may be present in treated wastewater are mitigated as they are readily oxidizable and/or biodegradable through the Ozone/BAC process. By understanding the fate and chemical properties of the recalcitrant CECs through the Ozone/BAC process, we can now assess additional treatment barriers (upstream and/or downstream) that may be needed to fully address CECs that are toxicologically relevant (see Chart 2).

Continually measuring the hundreds of CECs that may be present in treated wastewater is n[illegible]ractical fro[illegible] implementation and opera[illegible]erspective. A[illegible]tional challenge is characte[illegible] the water q[illegible]ty and [illegible]rowing down the CECs to thos[illegible]at are toxicolo[illegible]lly re[illegible]ant. To design the appropriat[illegible] [illegible]arrier [illegible]atme[illegible] rain to p[illegible]ect public health, t[illegible] are many CE[illegible] that m[illegible] be [illegible] in detectable c[illegible]entrations that [illegible]y be safe but ar[illegible]epresentative of a l[illegible]r family of chemicals [illegible]ith si[illegible]r structures or rea[illegible]ity. Therefore, it is more [illegible]ctica[illegible] assess the treatment efficiency of a unit p[illegible]ess o[illegible]ent train for this group of CECs, which [illegible] called performance-based indicators.

Surrogate parameters are important for ensuring the performance of an Ozone/BAC process from a CEC removal perspective. Since online sensors do not yet exist to continually identify and measure CECs in real-time, surrogates are online parameters that are readily available for monitoring and control of the Ozone/BAC process in rea[illegible]ime. T[illegible]e sur[illegible]ate parameters provide an indirect pe[illegible]rma[illegible]ssessment of CEC removal (see Chart 3).

Chart 3:
EXAMPLES OF PERFORMANCE-BASED INDICATORS AND SURROGATES

Indicator Compounds for Ozone	Indicator Compounds for BAC	Online Surrogates for Ozone/BAC
Meprobamate	Acetone	O_3/TOC
Sulfamethoxazole	Formaldehyde	ΔTOC
Gemfibrozil	NDMA	ΔUVT
Iohexol		
DEET		



In terms of project implementation, an important consideration is whether you have a treatment facility near the ocean where you have the capability for brine disposal. For facilities located inland, brine disposal may be cost-prohibitive. Non-RO treatment trains, such as CBAT may become a viable and robust option. The type/quality of source water entering the treatment plant is another consideration.

Given these factors, how do you determine which is a superior treatment option for your facility? And in some instances, is combining technologies to your advantage? That depends on a range of factors at each site, source waters, and the capability for brine or residual waste disposal.

Chart 2:
SOURCE WATER INPUT AND REMOVAL OF CECS WITH OZONE/BAC AND RO

THE Water Research FOUNDATION

Frequently Asked Questions related to CEC Removal by Ozone/BAC Treatment in Potable Reuse Applications

1. What is the fate of CECs through ozone and Ozone/BAC-based treatment and how does it correlate to performance goals from real-world data?
Ozone/BAC provides an excellent barrier to many types of CECs with removals of greater than 50%. Some CECs are resistant to both oxidation and biodegradation, such as synthetic organic compounds (e.g. flame retardants, contrast agents, etc.) but do not typically pose a significant health risk. Further treatment may be necessary to meet health-based goals for compounds of industrial origins, such as PFAS and NMOR.

2. What are the advantages and disadvantages of various Ozone/BAC-based treatment train configurations?
Advantages of Ozone/BAC-based treatment train configurations include less residual waste (i.e. no brine disposal) and often enhanced treatment redundancy, and overall lower cost.
Disadvantages of Ozone/BAC-based treatment train configurations include lack of TDS and nutrient removal (if source water quality is poor) and higher TO[illegible] If high TOC in the effluent is an issue (e.g. [illegible]P formation potential is too high to meet drinking wat[illegible]tandards due to poor source water quality and/or low [illegible]oduct TOC performance targets), then it may be mitiga[illegible] through the use of GAC and/or SAT after Ozone/BAC.

3. Is Ozone/BAC suitable for potable reuse (i.e. [illegible]face water augmentation, groundwater recharge, raw [illegible] augmentation)?
Yes. Ozone/BAC is a suitable advanced treatment process for all potable reuse applications. Whether it is selected and the degree to which additional treatment is implemented is highly dependent upon site-specific considerations including source water quality, regulations, cost, and residual management options.

4. Does Ozone/BAC do a better job against the bulk of CECs than RO?
Both Ozone/BAC and RO are considered best available technologies for addressing a majority of CECs. Reverse osmosis is more effective for removal of recalcitrant organics such as PFAS, whereas Ozone/BAC is not. On the other hand, Ozone/BAC provides a barrier for small molecular weight organics such as acetone, formaldehyde, and NDMA and is more effective at removing these types of compounds than RO. In the California context where regulations are more prescriptive, Ozone/BAC can be used together with RO to improve the performance of the overall treatment train, increase treatment redundancy, and achieve higher pathogen log removal needed for more direct forms of potable reuse. In other cases, such as One Water Nevada or Hampton Roads Sanitation District in Virginia, both of which include a relatively large environmental buffer, it may suffice to rely solely on Carbon-Based Advanced Treatment (CBAT) to accomplish treatment goals and to meet all drinking water standards.

5. Are there standard proces[illegible] criteria specific to Ozone/BAC for potable reus[illegible]ncluding [illegible]quipment characteristics?
The equipment used for ozo[illegible]BAC is t[illegible] same as what has been traditionally used in w[illegible]r treatme[illegible] for decades. Due to higher [illegible]s used [illegible] wastewat[illegible] effluent comp[illegible]d to drinking w[illegible]er, ozon[illegible]jection a[illegible]ution [illegible] be given caref[illegible]ideratio[illegible] ensure high mass t[illegible]sfer efficie[illegible] On th[illegible]her han[illegible] the high ozone de[illegible] rate in w[illegible]tewate[illegible]uent compared to drinking wa[illegible] often allo[illegible]uch smaller ozone contactors. A BAC [illegible]er is the same as a conventional granular media filter [illegible]ch is commonly used in both drinking water and wastewater reclamation applications.

The ozone system can be sized based on applied O3:TOC ratio between 0.5-1.5 depending on desired removal of CECs and/or target ozone residual for pathogen removal based on CT. BAC filters are typically designed to provide EBCT of 10-20 minutes.

6. What are the maintenance lessons learned from existing Ozone/BAC systems?
Both ozone and BAC systems can provide stable operation for years with an appropriate maintenance program. For example, ozone generators have a long service life of 10+ years, while support systems such as cooling, power supply, and oxygen supply systems will require more frequent maintenance. BAC systems are similar to conventional filtration systems and employ automatic valves that are simple but require periodic maintenance due to wear of components and seals over time. Backwash systems consisting of air supply and water pumps may require some preventive maintenance to support long operational life. Additionally, BAC systems don't require frequent media regeneration and replacement is only needed for periodic replenishment (~3% per year).

7. What are the real-time process monitoring and control approaches (operational and performance) for integrated Ozone/BAC systems?
Applying the proper ozone dose in real-time is essential for responding to fluctuating source water quality while maintaining consistent treatment performance. The effluent from a wastewater treatment plant will vary, often diurnally, leading to significant swings in TOC, ammonia, nitrate, and nitrite. The proper ozone dose is dependent upon the ozone demand in the influent water. Both TOC and nitrite have significant impacts on the ozone demand. And the ozone demand and decay may be very high in wastewater creating challenges for traditional process [illegible]onitoring and [illegible] approaches, such as the [illegible]method where d[illegible] oz[illegible] residual may be d[illegible] to measure [illegible]d dis[illegible]d ozone analyzers may be [illegible]ficult to maintai[illegible] new [illegible] promising process monitoring [illegible]d control appro[illegible] targe[illegible] constant O3:TOC ratio and va[illegible] the [illegible]e dose [illegible]sed on [illegible]anges in TOC concentration to [illegible]ntain this cons[illegible]t O3:T[illegible] ratio. [illegible]ite is present in [illegible] water, then the [illegible]ne dose must [illegible] corrected to accoun[illegible] the ozone demand attributed [illegible]itrite. TOC and nitrite [illegible]alyzers are now available to i[illegible]ement this control method in real-time, which also has th[illegible]dvantage of being a feed-forward control loop allowing for [illegible]ponse to changing water quality conditions. In addition, process performance of ozone can be monitored based on changes in the UVT of the feed water, while BAC process performance is primarily monitored for stable removal of TOC.

8. What unique benefits does Ozone/BAC provide when considering treatment train options?
Ozone/BAC is typically one of the first unit operations in an advanced water treatment train. Since Ozone/BAC significantly improves the water quality (i.e. reduces the bulk organic load), all unit operations downstream of Ozone/BAC will be more efficient. This may result in a reduction of capital equipment costs (i.e. higher flux rate through the MF system means less membranes, lower UV dose for the AOP system) and a reduction in O&M costs (less frequent chemical cleanings of both MF and RO systems due to more controlled organic fouling and lower energy use by MF, RO, and UV/AOP due to ability to reduce the use of chloramines for control of biological fouling, which also lowers chemical costs). For CBAT treatment trains, Ozone/BAC provides similar benefits of lowering the organics concentration for subsequent use of GAC for additional removal of TOC and significantly improves UVT for downstream disinfection by UV and UV/AOP system performance.

9. Are there substantial cost differences between the use of Ozone/BAC and other treatment processes?
The cost of an advanced water purification facility is very site-specific and dependent upon many factors including source water quality, product water treatment targets, cost of power and chemicals, and residual management. Additionally, the cost must be viewed holistically with respect to the entire treatment train and not with just one single unit operation. However, generally speaking as a rule of thumb, an Ozone/BAC-based treatment train without RO (i.e. CBAT) is less expensive than an RO-based treatment train. This is even more true when brine management becomes a s[illegible]ificant implementation challenge and further increa[illegible] project costs.

10. What are re[illegible]mended public outreach methods to [illegible] Ozone/[illegible]?
To educ[illegible] and in[illegible] the public and interested stakeh[illegible] (i.e. s[illegible]ols, elected officials, regulators, lo[illegible] orga[illegible]tions [illegible] the medical community) in these [illegible]cesses [illegible]s been important to promote on-site t[illegible] of [illegible]nstration and pilot-scale facilities so they can see firsthand the treatment process in operation. Several utilities have included graphical representations of treatment trains on their websites. PowerPoint presentations have been conducted at public meetings and in virtual online meetings during the pandemic. In some cases, videos have been made demonstrating the treatment train process using both real images as well as animations to help show how each treatment process works and how it removes different CECs, pathogens, and achieves drinking water and other standards. In addition, the facilities that have demonstration sites that include the tasting of advanced purified water has proven to be an excellent approach toward changing views and public acceptance of new treatment trains for potable reuse projects.

Dedicated project websites have also shown to be vital in making information available to the public and project stakeholders 24/7. This would include testimonials (written or videotaped) from knowledgeable people in the industry or from local and regional colleges/universities that are willing endorse the validity of these new treatment processes.

Glossary of Terms —
Carbon-based Advanced Treatment (CBAT) • Concentration x Time (CT) • Constituents of Emerging Concern (CEC) • Empty Bed Contact Time (EBCT) • Granular Activated Carbon (GAC) • Ion Exchange (IX) • Microfiltration (MF) • N-Nitrosomorpholine (NMOR) • Operations & Maintenance (O&M) • Ozone-enhanced Biologically Active Carbon (Ozone/BAC) • Per- and polyfluoroalkyl substances (PFAS) • Total Organic Carbon (TOC) • Ultraviolet (UV) • Ultraviolet Advanced Oxidation Process (UV/AOP) • Ultraviolet Transmittance (UVT)

Project Team for WRF 4832

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WateReuse California
Communications Collaborative Group

Pharmaceutical Management Subcommittee

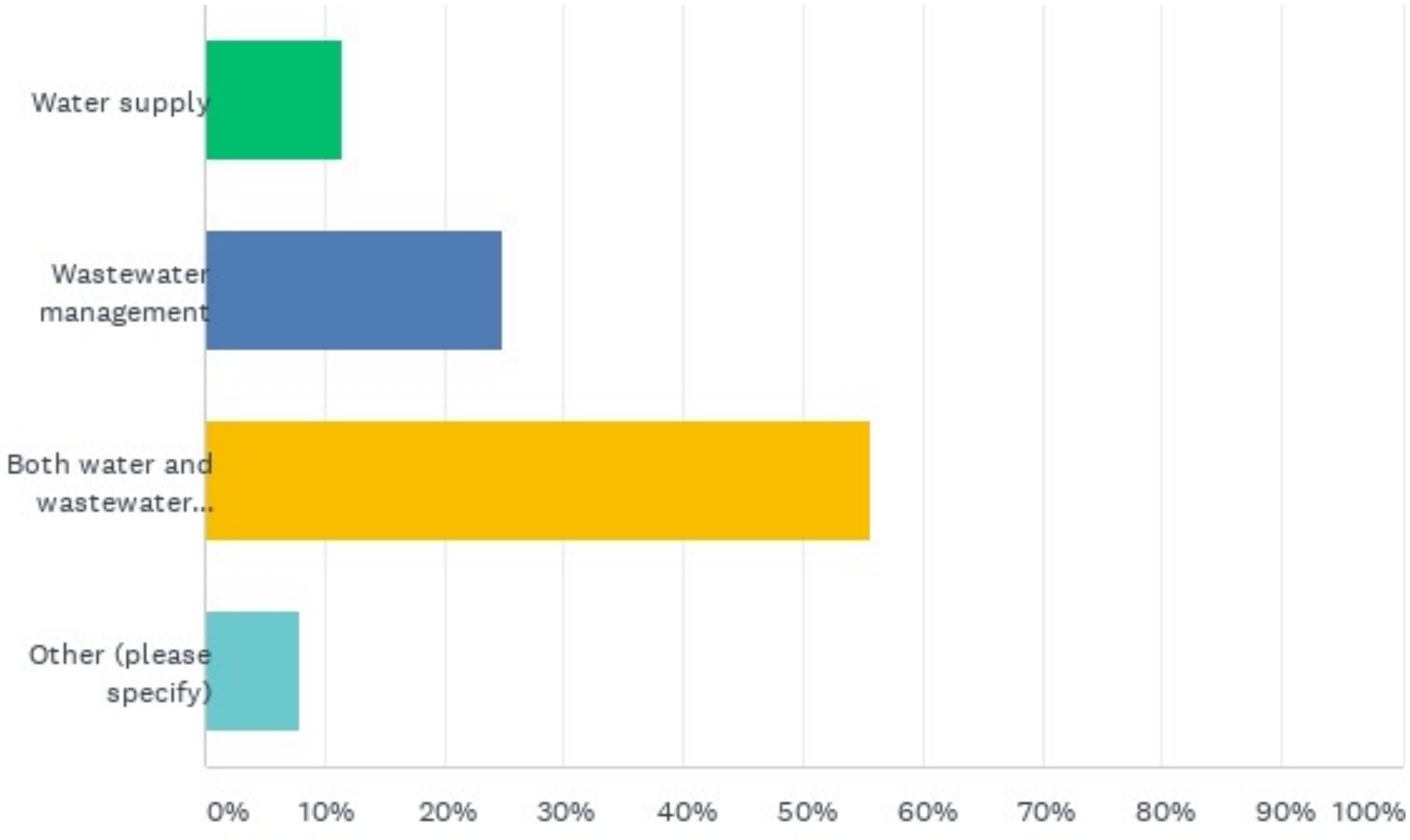
Sharon Green,
Los Angeles County Sanitation Districts | 12/9/2021

Survey: Communicating About Pharmaceutical and CEC Management in Recycled Water

December 9, 2021

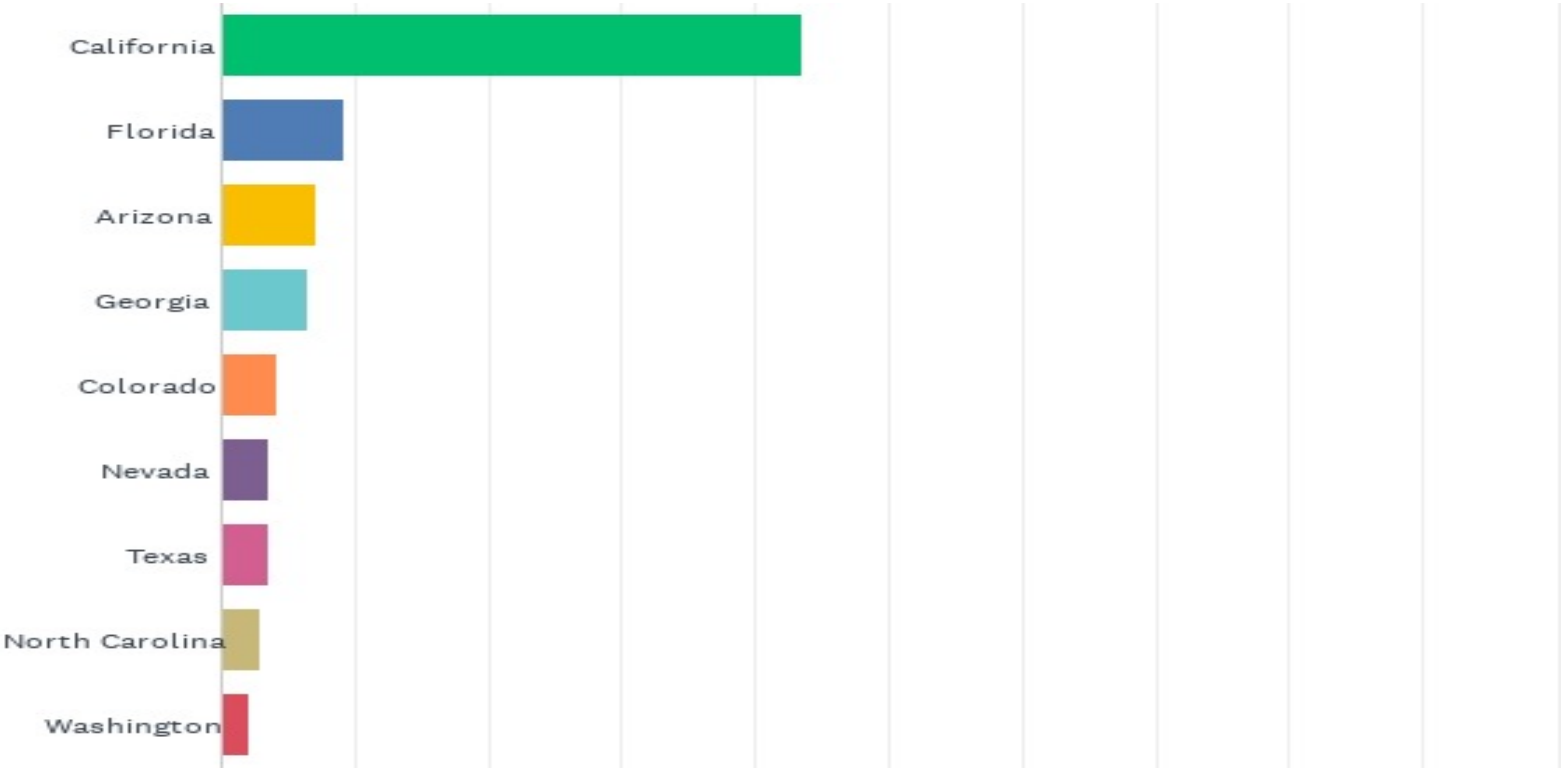
Q2: What category below best describes your organization's principal activity? Please select one.

Answered: 140   Skipped: 0



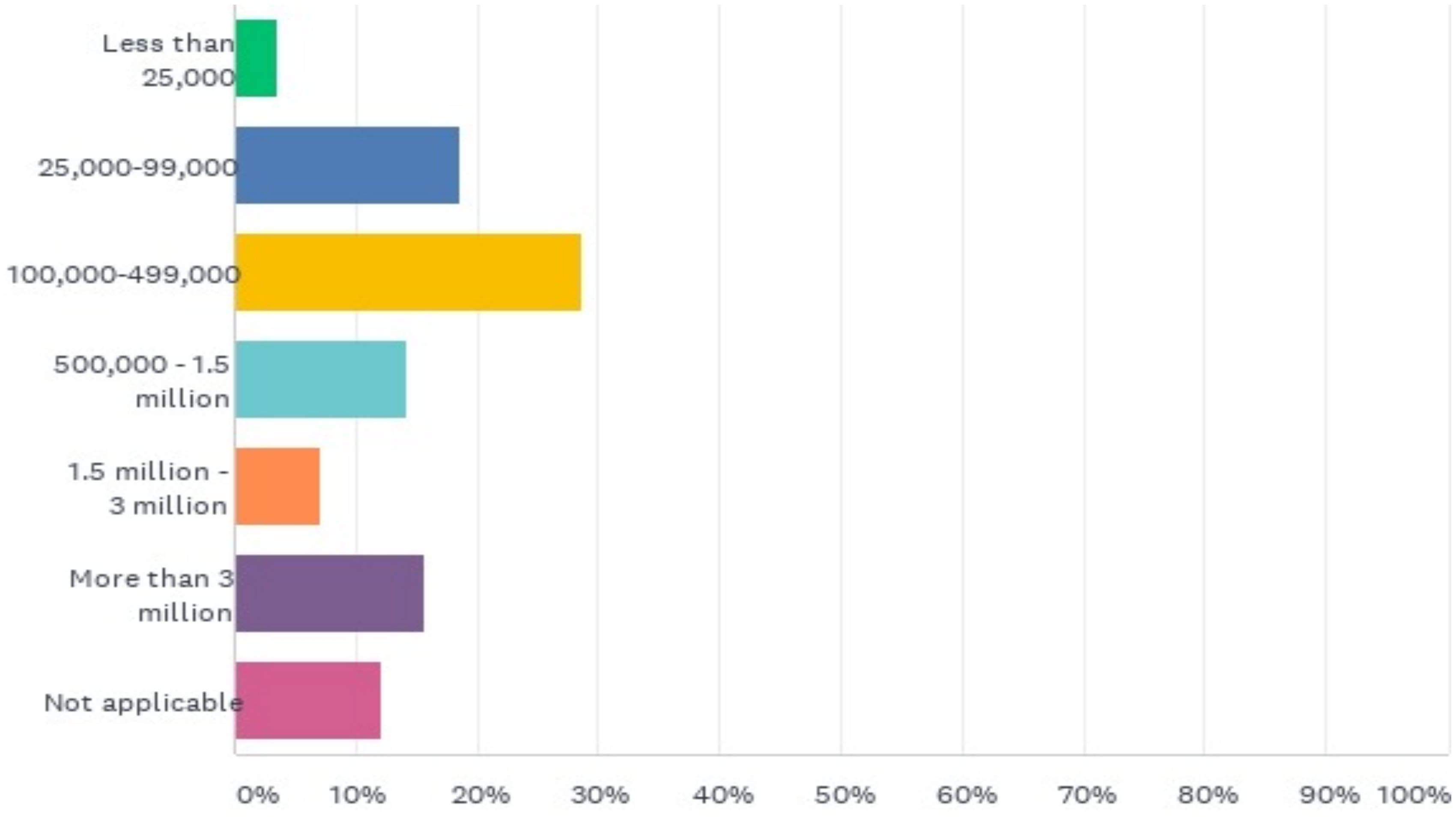
Q3: In what state or U.S. territory is your organization based?

Answered: 140   Skipped: 0



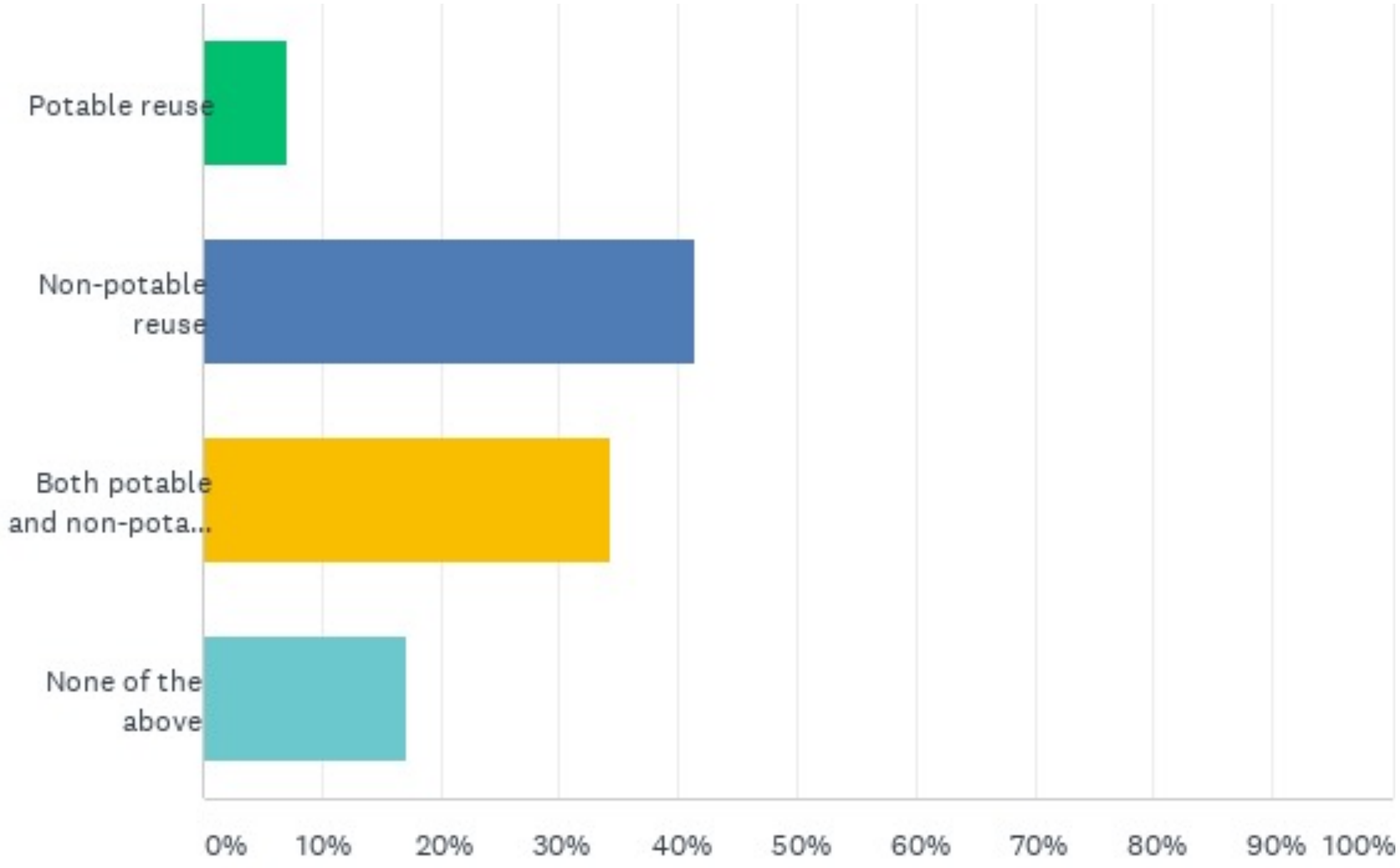
Q4: What is the population of your organization's service area?

Answered: 140 Skipped: 0



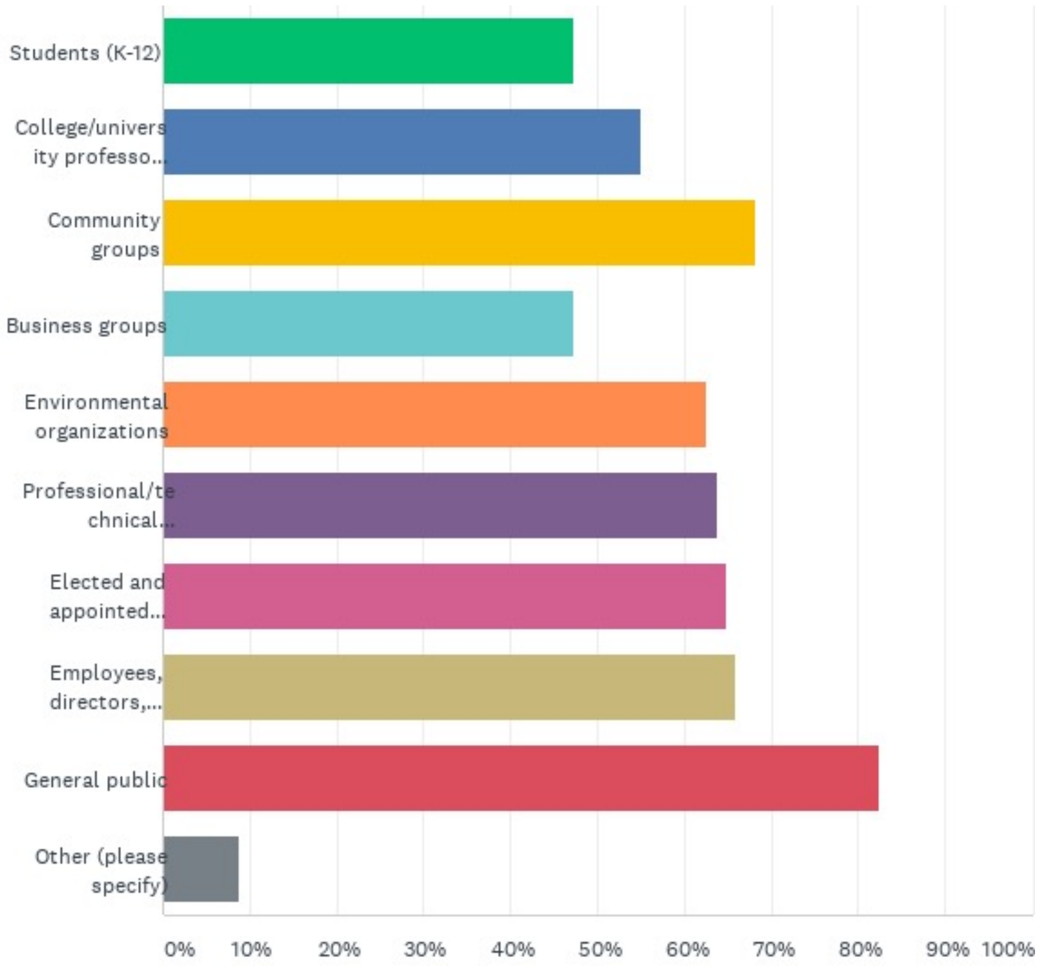
Q6: Please indicate the type of reuse your organization is involved with. Please check one answer.

Answered: 140   Skipped: 0



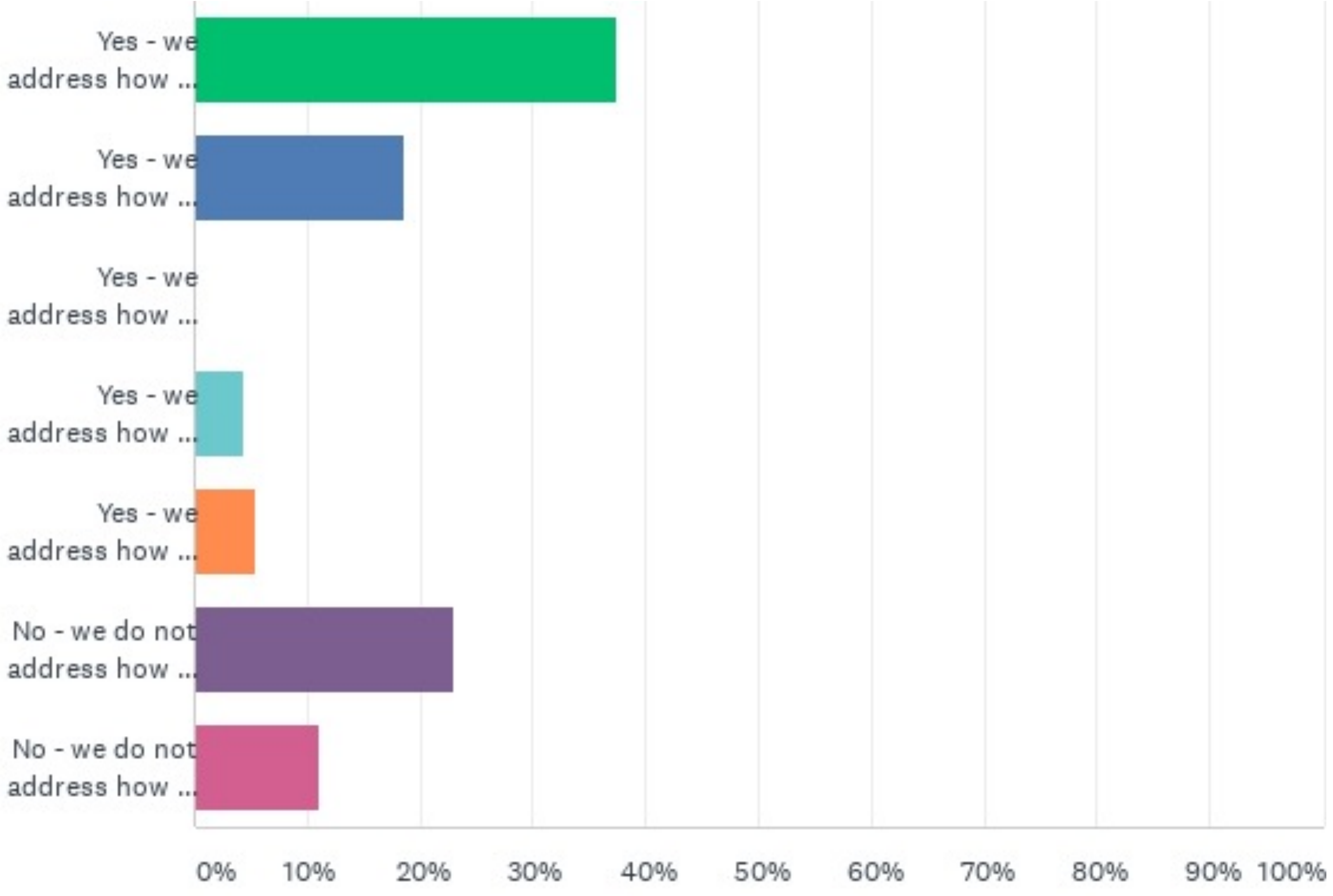
Q10: Which audiences do you communicate with? Please check all that apply.

Answered: 91   Skipped: 49



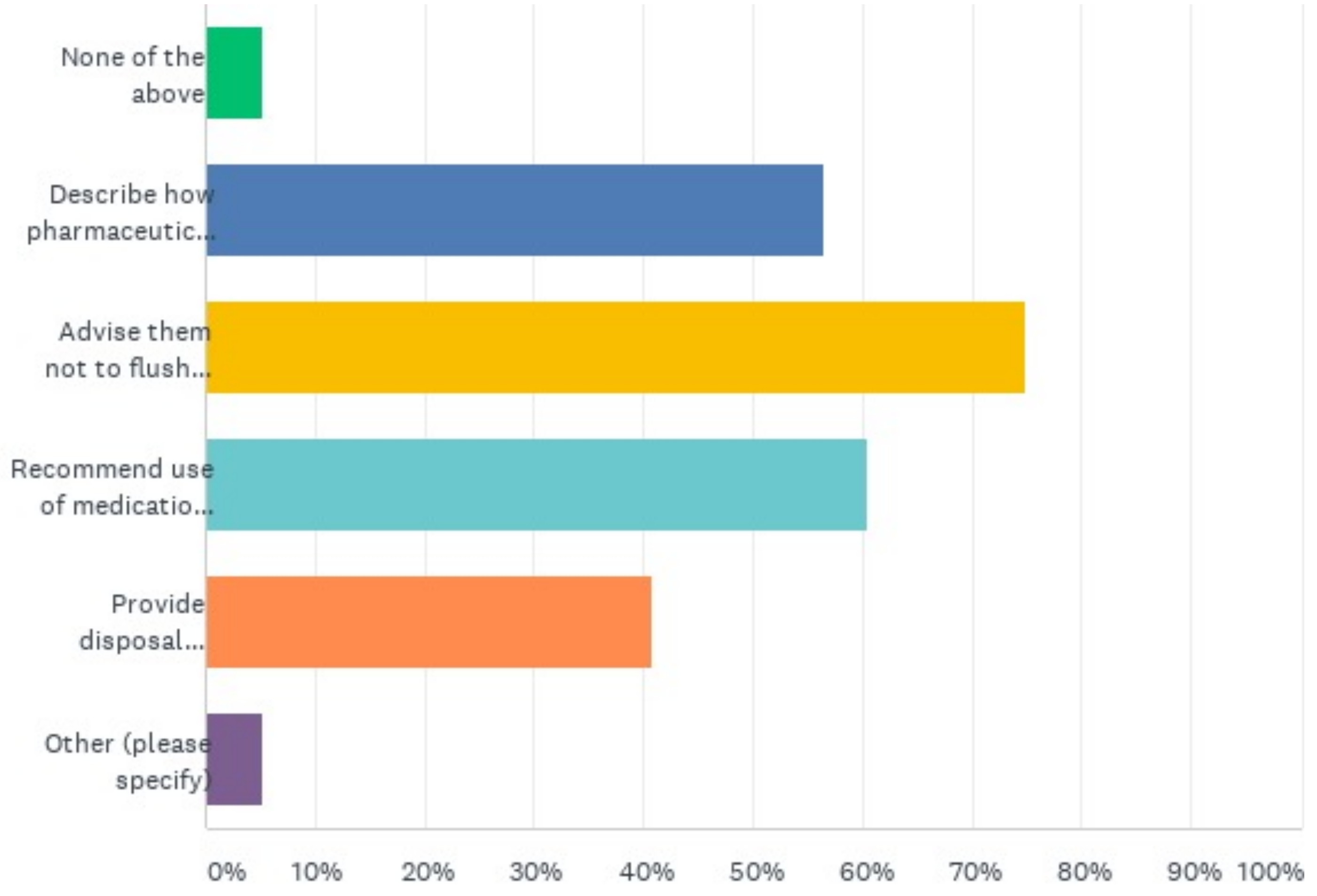
Q11: Do you address removal and/or management of chemicals of emerging concern (CECs) in your communications? CECs include pharmaceuticals, personal care products, industrial chemicals, and other chemical compounds. Please check the answer that best applies to your situation.

Answered: 91 Skipped: 49



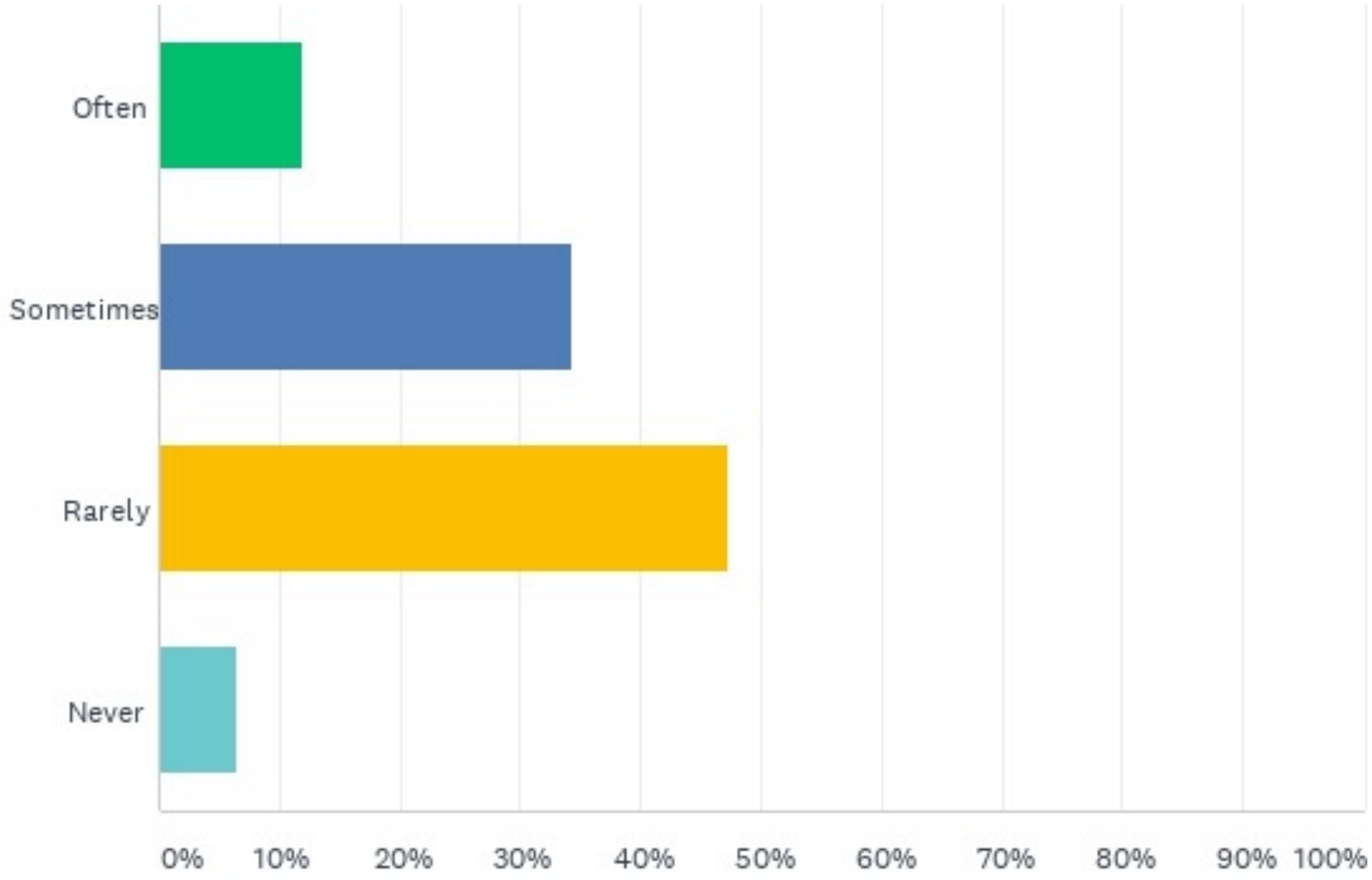
Q12: What messages do you use with the public to address pharmaceutical management in recycled water? Please check all that apply.

Answered: 76   Skipped: 64



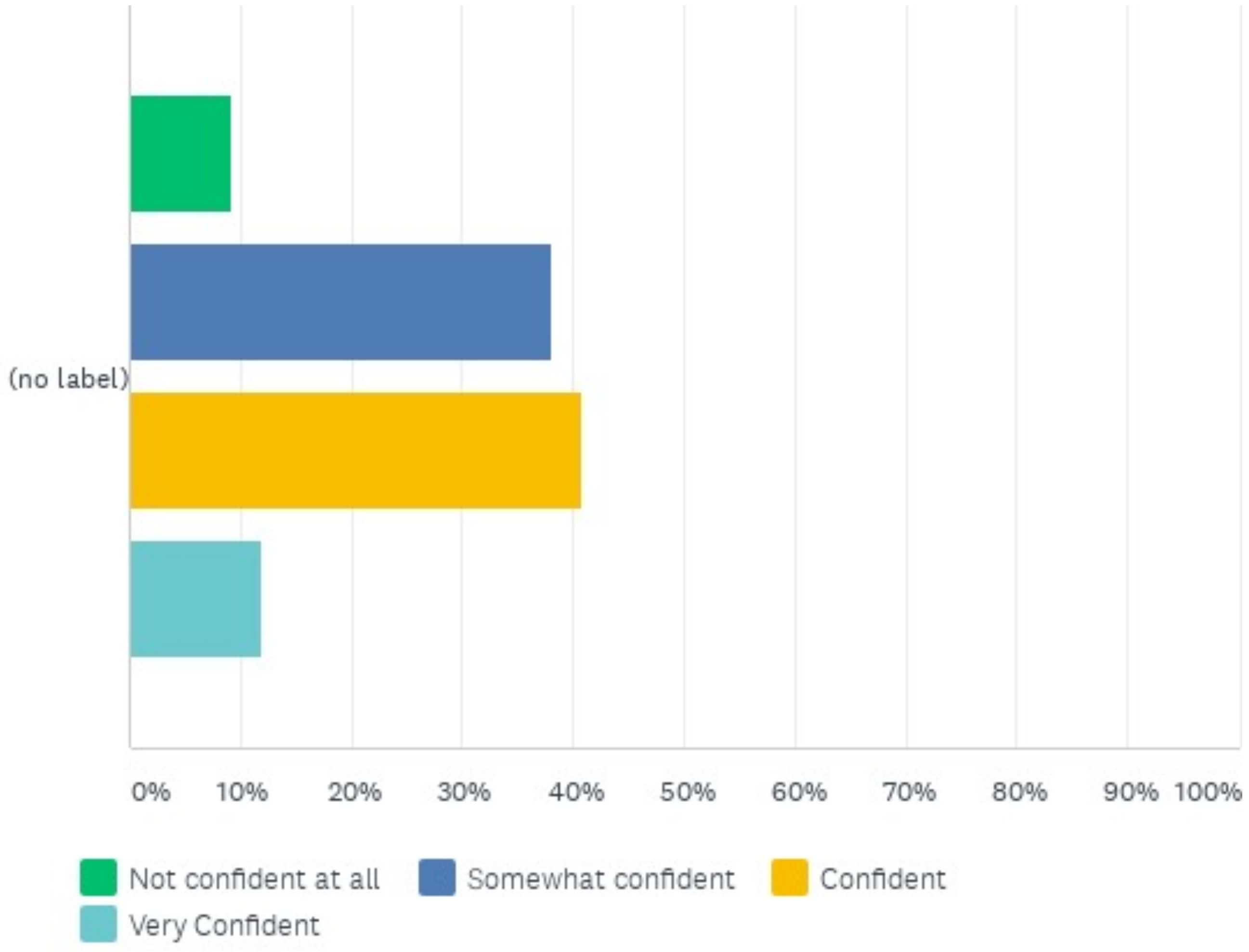
Q16: How frequently do you get questions or hear concerns about pharmaceuticals in recycled water? Please select one answer that best describes your experience.

Answered: 76   Skipped: 64



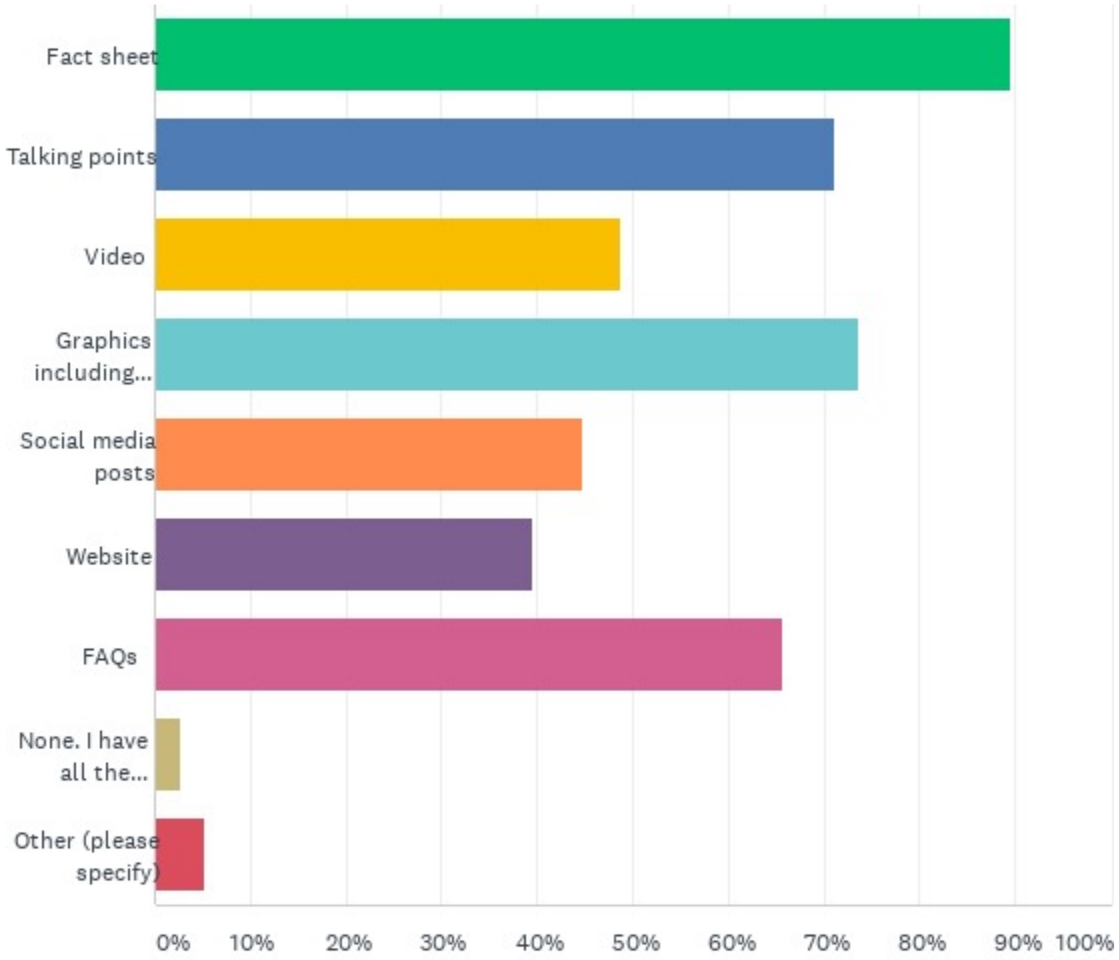
Q17: How confident do you feel when you communicate about CEC or pharmaceutical management and/or removal in recycled water?

Answered: 76   Skipped: 64



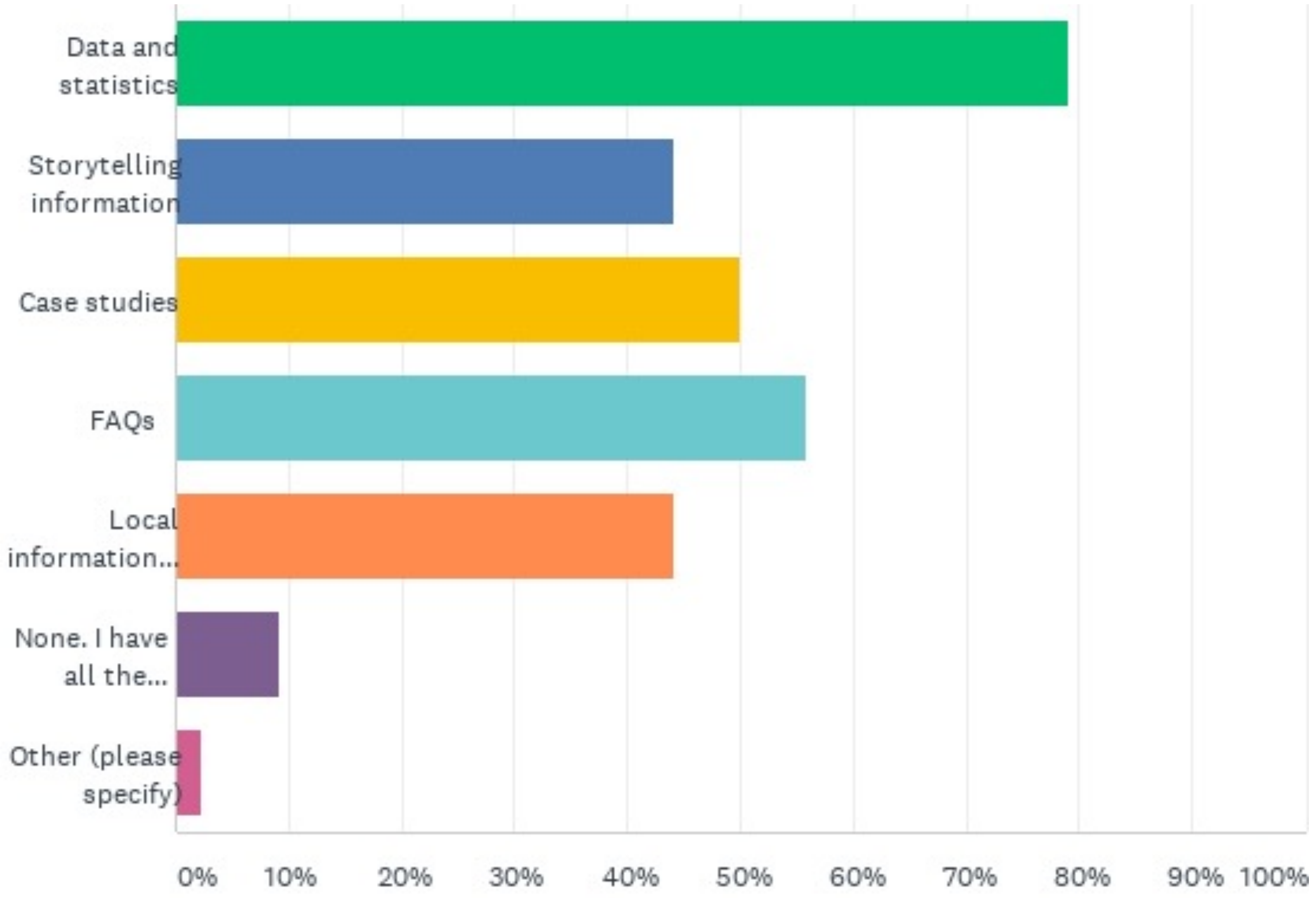
Q18: What additional collateral resources would be helpful to you in your communications in addressing CECs including pharmaceuticals in recycled water? Please check all that apply.

Answered: 76   Skipped: 64



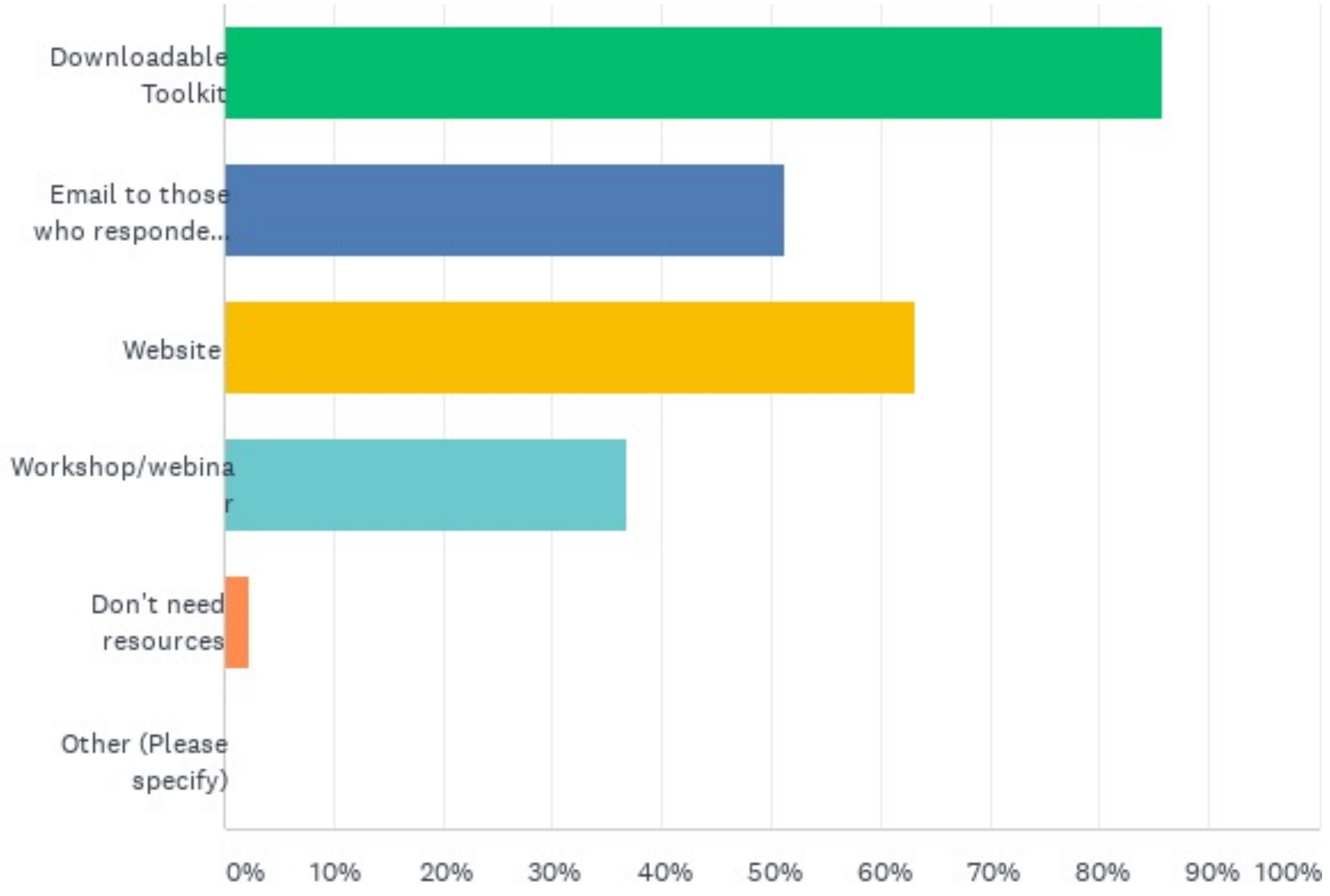
Q19: What additional informational resources would be helpful to you in your communications in addressing CECs including pharmaceuticals in recycled water? Please check all that apply.

Answered: 86 Skipped: 54



Q21: How would you prefer to receive any informational and collateral resources? Please check all that apply.

Answered: 84   Skipped: 56



Main Takeaways

- Those communicating about CECs and pharmaceuticals in water are mostly involved with both wastewater and water supply, as well as supplying recycled water. Many of these agencies are located in drought-stricken areas within the United States.
- Most recycled water communicators hold executive or management positions or are in outreach/communications positions.
- There appears to be a tendency to emphasize different messaging for wastewater vs drinking water agencies.
    - Wastewater – emphasize "do not flush," takeback opportunities and proper disposal.
    - Drinking water – focus on treatment system removal of CECs & pharmaceuticals.
- Although the public is not consistently asking a lot of questions about CECs & pharmaceuticals, many respondents would like to have convenient centrally-located, downloadable resources available with current, science-based customizable information. Opportunity exists to cross-pollinate the water and wastewater agency messaging.

Open Discussion

WateReuse California Communications Collaborative Group

WateReuse California Communications Collaborative Group

Recent Media

Becca Rubin,
Soquel Creek Water District

12/9/2021

WATEREUSE CALIFORNIA

Communications COLLABORATIVE GROUP

Roundtable Discussion

Roundtable led by:
Gina Ayala,
Orange County Water District

8/4/2021

WateReuse California

Communications

COLLABORATIVE GROUP

Thank you for participating!